# United States Patent [19]

**Derrick et al.**

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[54] **REINFORCED MOLDED POLYURETHANE VIBRATORY SCREEN**


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[73] Assignee: **Derrick Manufacturing Corporation**, Buffalo, N.Y.



[ * ] Notice: The portion of the term of this patent subsequent to Apr. 11, 2006 has been disclaimed.

[21] Appl. No.: **210,153**

[22] Filed: **Jun. 17, 1988**

**Related U.S. Application Data**

[63] Continuation of Ser. No. 892,307, Aug. 4, 1986, abandoned.

[51] **Int. Cl.**[4] ..... **B07B 1/46**

[52] **U.S. Cl.** ..... **209/392**; 209/393; 209/400

[58] **Field of Search** ..... 209/392, 400, 397, 393, 209/352, 401, 403, 405, 275



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[57] **ABSTRACT**

A molded polyurethane vibratory screen including a body having opposite side edge portions, upper and lower edge portions, an upper surface and a lower surface, a plurality of major and minor substantially parallel ribs extending between the upper and lower edge portions and substantially parallel to the side edge portions, dividing strips extending between the major and minor ribs to define screen openings therebetween, aramid fibers extending between the side edge portions and through the dividing strips to provide tensile strength to the dividing strips, and upper triangular cross section portions formed integrally with the major and minor ribs and extending above the upper surface of the screen to direct foreign matter laterally toward the screen openings. The dividing strips are preferably in the cross-sectional form of an inverted trapezoid, or in a form having an upper portion in the shape of an inverted trapezoid and the lower portion in the shape of a rectangle.


**20 Claims, 2 Drawing Sheets**

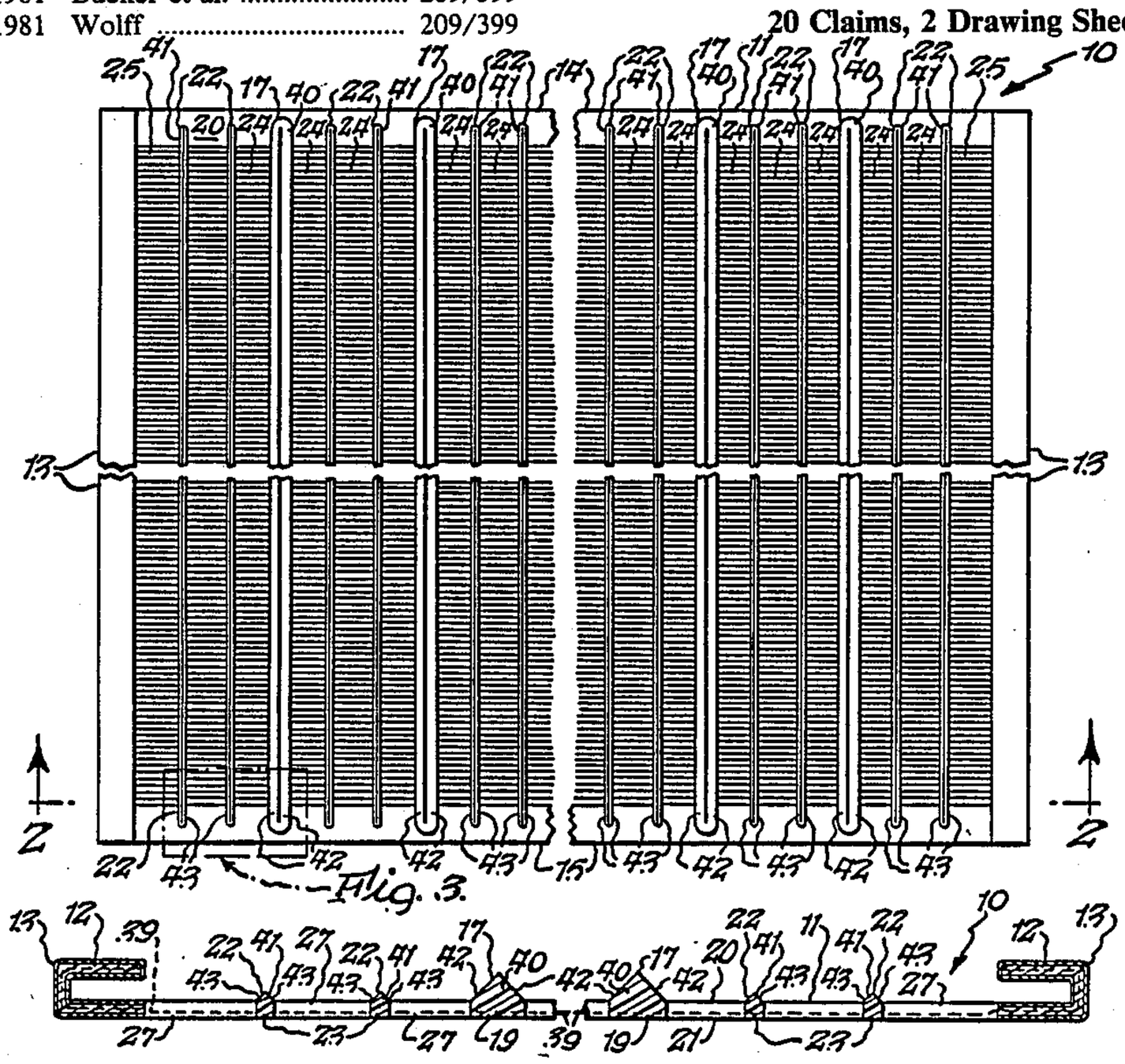

Fig. 3.

Fig. 1.

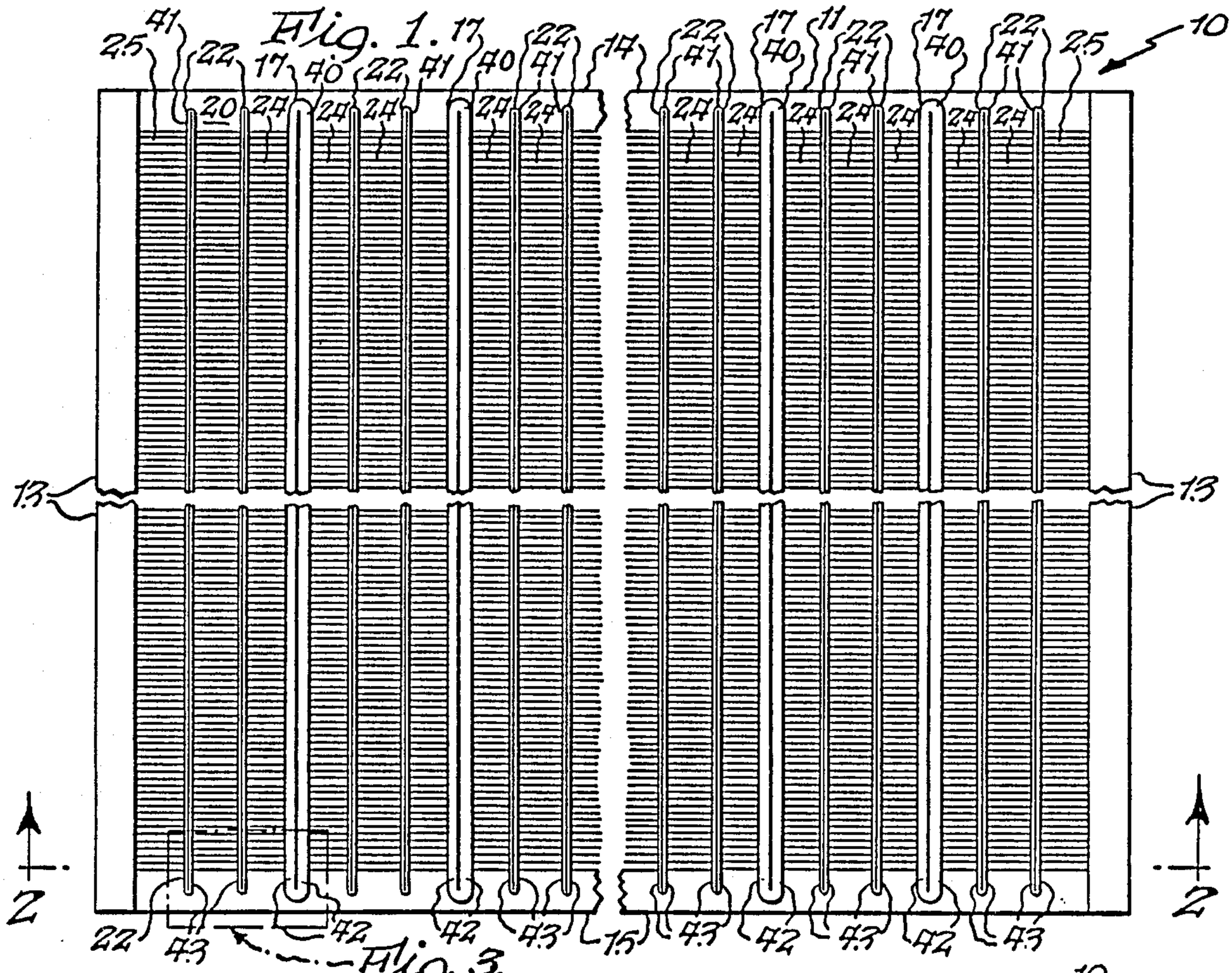


Fig. 3.

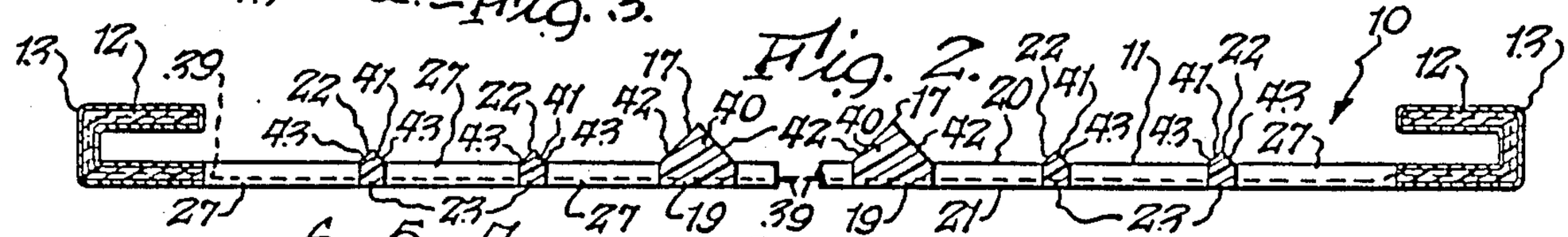


Fig. 2.

Fig. 3.

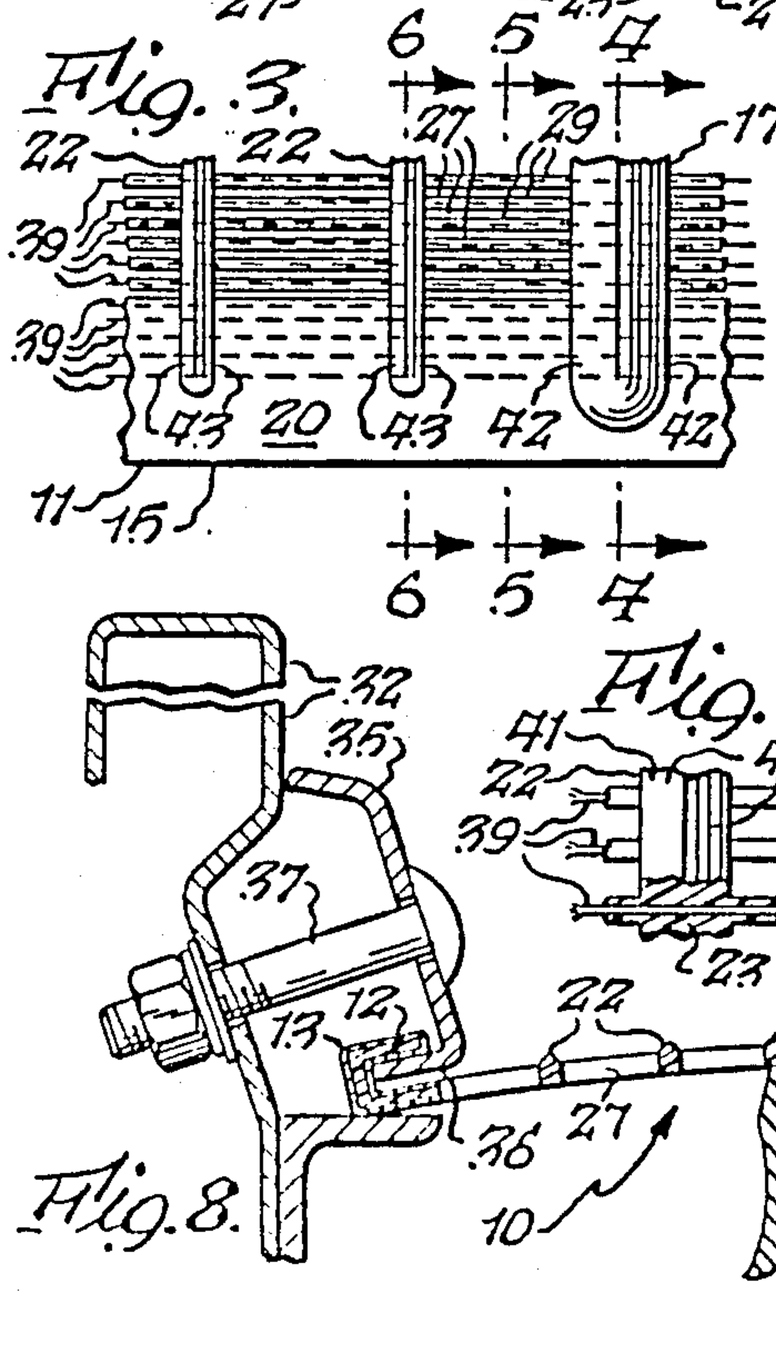


Fig. 4.

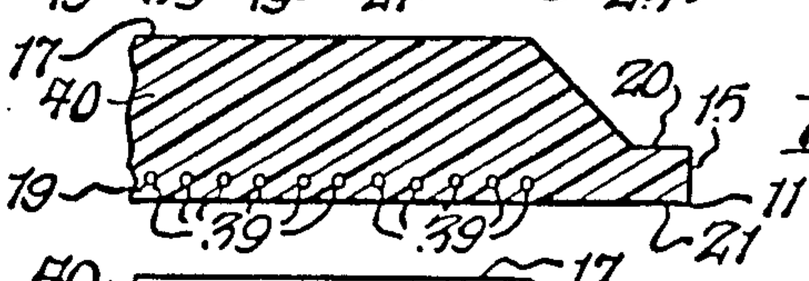


Fig. 5.


Fig. 6.

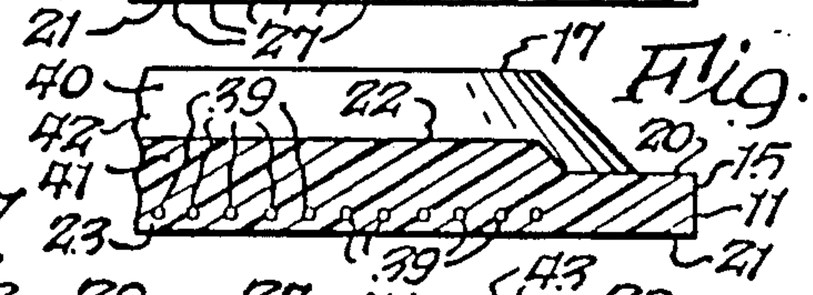


Fig. 7.




Fig. 8.

Fig. 9.

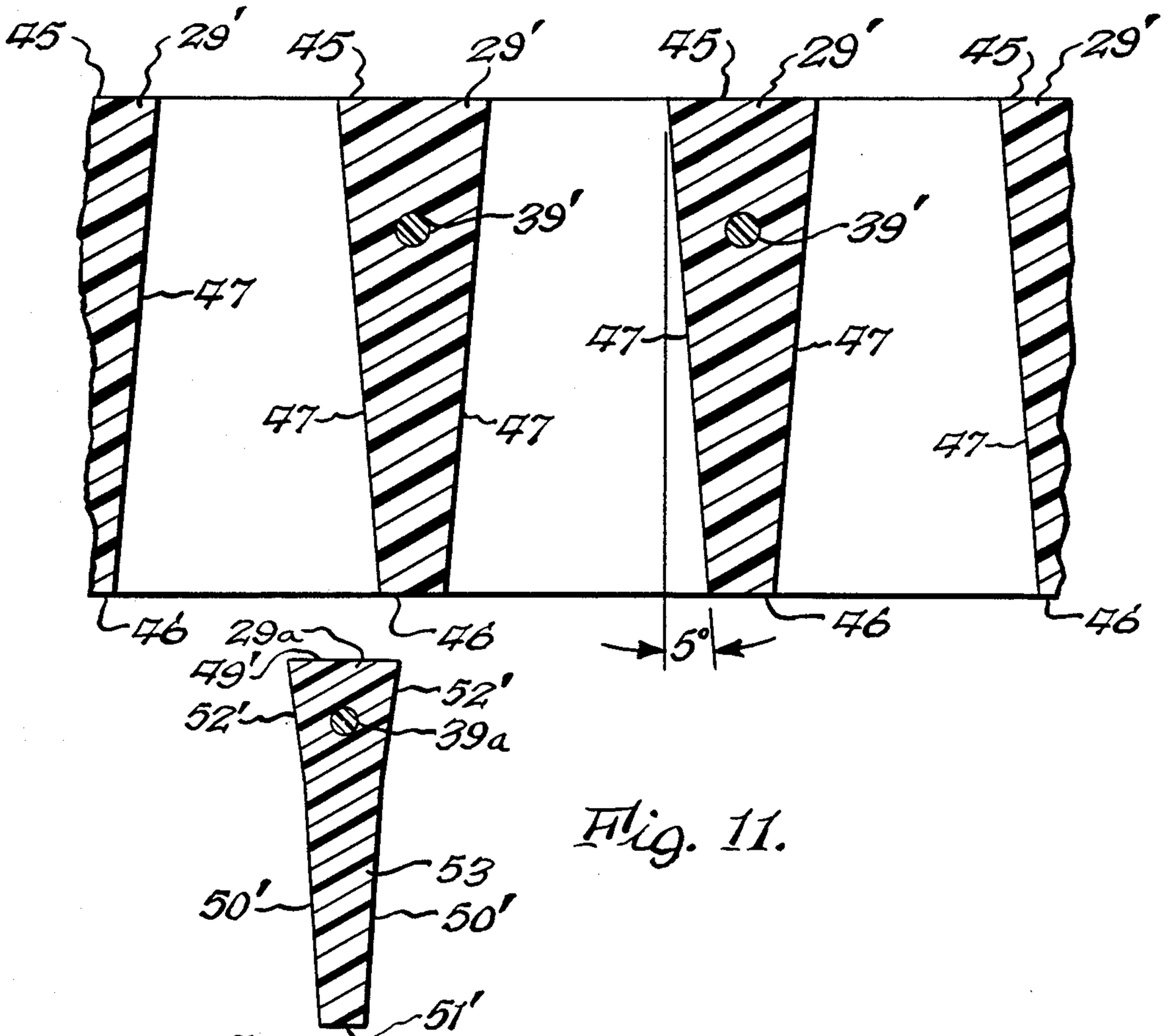


Fig. 11.

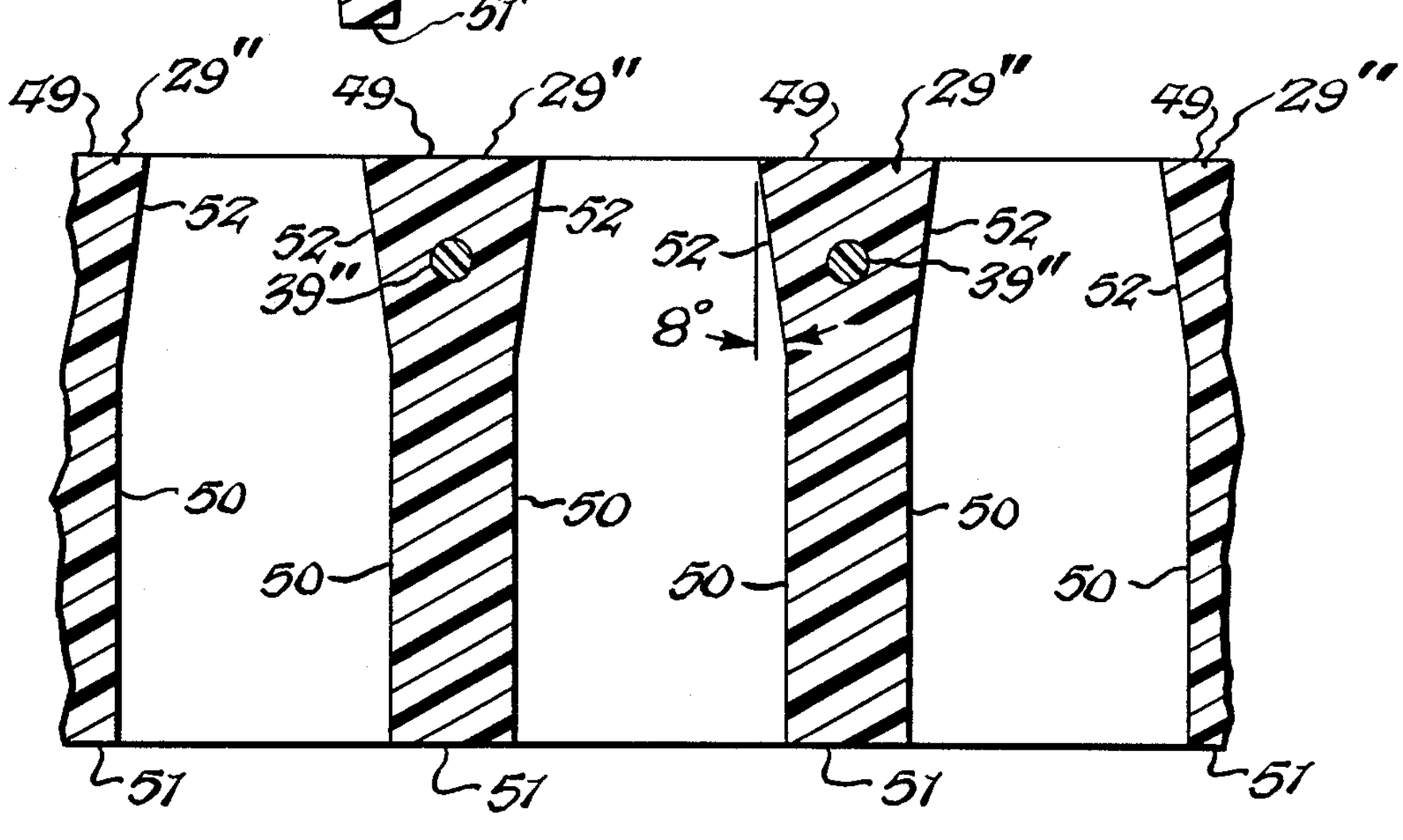


Fig. 10.

# REINFORCED MOLDED POLYURETHANE VIBRATORY SCREEN

This application is a continuation of application Ser. No. 892,307, filed Aug. 4, 1986, now abandoned.

## BACKGROUND OF THE INVENTION

The present invention relates to an improved molded polyurethane screen.

By way of background, molded polyurethane screens which have reinforcement therein are known in the art. However, in the past the dividing strips between the openings were relatively large, thereby causing the open area of the screen to be an undesirably low percentage of its surface, thereby in turn causing the screen to be relatively inefficient. In copending application Ser. No. 773,994, filed Sept. 9, 1985, an improved reinforced polyurethane screen construction is disclosed, and the present invention is an improvement thereof.

## SUMMARY OF THE INVENTION

It is one object of the present invention to provide an improved molded polyurethane screen which has a relatively high percentage of open area to thereby produce high efficiency because the dividing strips between the screen openings can be made relatively narrow since they are reinforced by high tensile strength reinforcing materials which are relatively small in diameter, and which has very little tendency to clog because of the shape of the dividing strips.

Another object of the present invention is to provide an improved molded reinforced polyurethane screen which includes upper rib portions above the upper surface of the screen which are of a shape to direct water and material to be screened toward the screen openings, and which has very little tendency to clog because of the shape of the dividing strips. Other objects and attendant advantages of the present invention will readily be perceived hereafter.

The present invention relates to a vibratory screen comprising a molded polyurethane body, an upper surface on said body, screen openings in said body, substantially parallel adjacent dividing strips on opposite sides of said screen openings, and elongated aramid fibers molded integrally with said dividing strips to impart tensile strength thereto, said screen openings being of a shape such that the spacing between said adjacent dividing strips is larger below said upper surface than at said upper surface.

The present invention also relates to a vibratory screen comprising a body having side edge portions and upper and lower edge portions and an upper surface and a lower surface, a plurality of substantially parallel dividing strips extending longitudinally between said side edge portions to define edges of screen openings therebetween, rib means extending transversely to said dividing strips to define ends of said screen openings, ridge means extending outwardly from said upper surface in a direction transverse to said dividing strips for directing material into said openings, said openings being of a shape such that the spacing between adjacent dividing strips below said upper surface is greater than at said upper surface.

The present invention will be more fully understood when the following portions of the specification are read in conjunction with the accompanying drawings wherein:



## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a fragmentary plan view of the improved vibratory screen of the present invention;

FIG. **2** is a fragmentary cross sectional view taken substantially along line **2—2** of FIG. **1**;

FIG. **3** is a fragmentary enlarged view of the portion of the lower left corner of FIG. **1** bounded by dot-dash lines;

FIG. **4** is a fragmentary cross sectional view taken substantially along line **4—4** of FIG. **3**;

FIG. **5** is a fragmentary cross sectional view taken substantially along line **5—5** of FIG. **3**;

FIG. **6** is a fragmentry cross sectional view taken substantially along line **6—6** of FIG. **3**;

FIG. **7** is a fragmentary enlarged view of a portion of FIG. **3**;

FIG. **8** is a fragmentary cross sectional view showing the manner in which the improved screen of FIG. **1** is mounted in a vibratory screening machine;

FIG. **9** is an enlarged fragmentary cross sectional view similar to the view taken substantially along line **5—5** of FIG. **3**, but showing only the cross-sectional configuration of a modified shape of the dividing strips;

FIG. **10** is a view similar to FIG. **9** but showing a still further modified cross-sectional configuration of the dividing strips; and

FIG. **11** is a view showing a still further modified cross sectional configuration of a dividing strip.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

The vibratory screen **10** includes a body **11** of molded polyurethane having unperforated side edge portions **12** which are encased in a U-shaped metal frame **13** for mounting in a vibratory screening machine, as is well known. The body **11** also includes an upper edge portion **14** and a lower edge portion **15** which, in combination with side edge portions **12**, define the outer border of the screen **10**.

A plurality of relatively large major ribs **17** extend between edge portions **14** and **15** and include lower rib portions **19** (FIG. **2**) which are located between upper surface **20** and lower surface **21** of body **11**. In addition, a plurality of relatively small substantially parallel minor ribs **22** also extend between edge portions **14** and **15** and include portions **23** which are located between upper surface **20** and lower surface **21**. Thus, ribs **17** and **22** divide body **11** into a plurality of column-like spaces **24**. In addition two column-like spaces **25** are defined by the outermost ribs **22** and side edge portions **12**.

The column-like spaces **24** and **25** are further divided into openings **27** by dividing strips **29** which are molded integrally with the ribs **22** and **17** at opposite ends thereof. The openings **27** are, in accordance with the present invention, 1.5 mm wide and approximately 25 mm long. However, the width may be slightly larger, on the order of about 2 or 3 mm, or as small as 0.25 mm wide. The distance between upper surface **20** and lower surface **21** may be approximately 3 mm. Thus it can be seen that the screen openings **27** are elongated with a greater length dimension along the sides of the screen openings and between the ribs than a width dimension between the sides. Furthermore, as can be seen, the length dimension of the openings extends in a direction transverse to the side edge portions **12**.

In use, the vibratory screen **10** is mounted on a vibratory screening machine **30** (FIG. **8**) in the well known

manner. More specifically, it is mounted on the screen deck bed **31** which is mounted on the frame (not shown) of the machine. The screen deck bed **31** consists of spaced substantially parallel frame members **32** secured to each other by spaced substantially parallel cross frame members (not shown). Extending transversely between the cross frame members are a plurality of substantially parallel stringers **33** which mount channel rubbers **34**. Mounted on parallel frame members **32** are channel-shaped draw bars **35** having lower portions **36** which are received within channel members **13**. Draw bolts **37** draw bars **35** apart to thereby tension vibratory screen **10** with the required force. The foregoing type of screen deck bed is well known in the art.

The polyurethane is flexible and has a creep characteristic so that, if unmodified, it will stretch and lay loosely on members **34**, rather than tightly, as required. In order to overcome the foregoing, aramid fibers **39** extend longitudinally of and are embedded in dividers **29**. Each fiber **39** extends completely across body **11** including the side edge portions **12**. The continuous fibers **39** have a tensile strength which is greater than steel and thus they prevent the body **14** from elongating between side edge portions **12** when it is mounted under high tension on the vibratory screening machine, as shown in FIG. **8**. Preferably fibers **39** are slightly tensioned before the polyurethane is molded around them. In addition, fibers **39** are preferably multistrand so that they act in the nature of wicks to absorb the polyurethane which is molded around them to thereby provide an extremely good bond therewith. The flexibility of the aramid fibers **39** thus provides a flexible reinforcement system for the molded polyurethane which therefore is able to always return to its original molded shape regardless of the necessary bending and flexing during handling and installation into the vibratory frame member **32**. Furthermore, the flexible aramid fibers permit the flexible polyurethane screen to be flexed without harm into an arcuate condition and tensioned as shown in FIG. **8**. During operation, the thin flexible dividing strips **29** will vibrate to enhance the screening action. In this regard, it is to be noted that because dividing strips **29** are flexible and relatively thin and only slightly wider than fibers **39**, they will provide a relatively high amplitude of desirable vibration. The reason the reinforced dividing strips **29** can be made relatively thin is because the aramid fibers are about four times the tensile strength of steel and therefore can provide the required reinforcement while requiring only about one-fourth of the cross sectional area which would be required for steel. In addition, the making of the dividing strips relatively thin results in the screen having a greater percentage of open area than a screen with steel reinforcement would have, which, in turn, increases its capacity. The fibers **39** are located in the bottom halves of dividing strips **29** so as not to be exposed relatively early as the upper surface of the screen wears. The aramid fibers are commercially obtainable under the trademark KEVLAR of the Dupont Company and are further identified by the designation B29/6×02. Fiber strands **39** are preferably 0.5 mm in diameter and the individual filaments therein are in the order of 0.01 mm in diameter.

The major ribs **17**, which can be considered relatively large ribs, and the minor ribs **22** which can be considered relatively small ribs, each include upper ridge portions **40** and **41**, respectively, which are triangular in cross section. Triangular ridge portions **40** and **41** extend above upper surface **20**, and the bases of triangular portions **40** and **41** lie substantially in the plane of upper surface **20**. Thus, the sloping sides **42** and **43** of upper triangular portions **40** and **41**, respectively, will direct water and the material being screened laterally into the openings **27** adjacent thereto. This insures that the material to be screened will not pass downwardly along the ribs, and thus avoid being exposed to the openings.

By way of further dimensions, dividing strips **29** in the particular screen are approximately one mm wide. The lower major rib portions **19** are approximately 15 mm wide and the height of triangular portions **40** above upper surface **21** is approximately 7 mm. The lower minor rib portions **23** are approximately 3 mm wide and the height of triangular rib portions **41** above surface **21** is approximately 2 mm. The overall dimensions of screen **10** may be about 1.2 meters times 1.6 meters, or any other desired size. All of the dimensions are by way of example and not of limitation.

Representative preferred embodiments of the present invention are depicted in FIGS. **9–11**. The basic improvement consists of adding to the above-described structure, openings between the dividing strips which are larger below the upper surface than at the upper surface to obviate clogging. This is achieved by properly shaping the dividing strips, as appears hereafter.

In FIG. **9** one embodiment of the improved construction over the dividing strips **29** of FIGS. **1–8** is shown, and the improved dividing strips are designated by numeral **29′**. The vibratory screen containing these dividing strips is identical in all other respects to the screen described relative to FIGS. **1–8**, except for the location of the multistrand aramid fibers **39′**. Basically the dividing strips **29′** are in the shape of inverted trapezoids having larger bases **45** and smaller bases **46** and sides **47**. The preferred angle of inclination of sides **47** relative to the vertical is 5°, but usually it may be anywhere between 3° and 10°, and in certain instances, it can exceed 10°. By way of example and not of limitation, the screen depicted in FIG. **9** has openings of 0.055 inches between bases **45**; the width of base **45** is 0.045 inches and the width of base **46** is 0.02 inches; and the distance between bases **45** and **46** is 0.145 inches.

The multistrand aramid fibers **39′** are located on the longitudinal axis of dividing strips **29′** and, by way of example, are located 0.038 inches from bases **45**. The aramid fibers have a diameter of 0.009 inches. The individual filaments of multistrand fibers **39′** have a diameter of about 0.01 mm. The aramid fibers are commercially obtainable under the trademark KEVLAR of the Dupont Company and are further identified by the designation B29/4×02. The fibers **39′** are located in the upper half of dividing strips **29′**, that is, they are 0.038 inches from bases **45**. This placement provides stability proximate bases **45** to maintain the spaces therebetween fairly constant.

In FIG. **10** a still further modified embodiment of the improved dividing strips is shown. Dividing strips **29″** have upper portions in the shapes of inverted trapezoids with larger bases **49**. The lower bases (not numbered) merge into rectangular lower portions having sides **50** which terminate at ends **51**. The sides **52** of the trapezoidal portions are inclined at an angle of 8° to bases **49**. However, this angle can be anywhere between 3° and 10° and, in certain instances, even larger. By way of example, and not of limitation, the spacing between bases **49** is 0.055 inches; bases **49** are 0.045 inches wide; the lower base of the trapezoidal portions is 0.05 inches

from base **49** and the distance between base **49** and end **51** is 0.145 inches.

The dividing strips **29''** include aramid fibers located on the longitudinal axes of dividing strips **29''** and located at 0.025 inches from bases **49**. Each multistrand aramid fiber **39''** is 0.009 inches in diameter and it includes a plurality of separate filaments each about 0.01 mm in diameter. As in the embodiment of FIG. **9**, the fibers **39''** are located in the upper half of dividing strips **29''** to provide stability thereto.

In FIG. **11** a still further improved dividing strip **29*a*** is shown which has an upper portion **52'** of inverted trapezoidal cross sectional configuration which merges into a lower inverted trapezoidal cross sectional configuration **53** having downwardly tapering sides **50'** which terminate at lower base **51'**. The aramid fiber **39** is located in upper portion **52'**. The sides of upper portion **52'** are inclined between 3° and 10° to the vertical, and sides **50'** are inclined a lesser amount than the sides of portion **52'**.

Except as noted above, the vibratory screens having the dividing strips of FIGS. **9–11** are identical in all respects to those described above in FIGS. **1–8**. The dimensions given above for the embodiment of FIGS. **9** and **10** are those for a screen having openings 0.055 inches and 0.72 inches long. These dimensions have been given strictly by way of example, and it will be appreciated that the dimensions of the dividing strips may vary with different sizes of openings.

While the dividing strips of the embodiments of FIGS. **9–11** are shown as symmetrical about their vertical axes, they need not be, that is, the opposite sides may be inclined at different angles to the vertical. In this respect, the various portions denoted as being trapezoidal and rectangular need not be exactly trapezoidal or rectangular but may be substantially trapezoidal or rectangular or even quadrangular, the main criterion being that the spaces between the sides of adjacent dividing strips below their upper surfaces should be larger than at their upper surfaces.

While preferred embodiments of the present invention have been disclosed, it will be appreciated that it is not limited thereto but may be otherwise embodied within the scope of the following claims.

What is claimed is:

**1**. A vibratory screen for mounting on a vibratory screening machine comprising an integral flexible molded polyurethane body having a creep characteristic, an upper surface and a lower surface on said body, side edge portions forming an integral molded portion of said body, screen openings in said body extending between said upper and lower surfaces, flexible dividing strips forming an integral molded portion of said body and defining opposite sides of each of said screen openings, ribs molded integrally with said dividing strips and extending transversely thereto and defining the ends of said openings, said screen openings being elongated with a greater length dimension along said sides and between said ribs than a width dimension between said sides and with their length dimensions extending in a direction transverse to said side edge portions, said screen openings also diverging downwardly between said upper surface and said lower surface, and continuous elongated flexible aramid fiber means molded integrally with each of said flexible dividing strips and extending continuously throughout said body and into said side edge portions for enabling tensioning of both said dividing strips and said fibers in a direction along the length of said flexible aramid fibers and said flexible dividing strips when tensile forces are applied to said side edge portions and said fibers therein and thus preventing said body from elongating between said side edge portions due to said creep characteristic while permitting said dividing strips to vibrate due to their flexibility when said body is mounted under high tension and is being operated on said vibratory screening machine, said aramid fiber means and said molded polyurethane body being sufficiently flexible to enable said vibratory screen to be bent into an arcuate condition for installation into said vibratory screening machine.

**2**. A vibratory screen as set forth in claim **1** wherein said fibers are multistrand, and wherein said polyurethane impregnates said multistrand fibers to thereby provide an intimate bond between said dividing strips and said fibers.

**3**. A vibratory screen as set forth in claim **1** wherein said dividing strips are substantially in the shape of inverted trapezoids.

**4**. A vibratory screen as set forth in claim **3** wherein the sides of said trapezoids are inclined between about 3° and 10° to the vertical.

**5**. A vibratory screen as set forth in claim **1** wherein said ribs comprise relatively large ribs located between relatively small ribs.

**6**. A vibratory screen as set forth in claim **1** wherein said dividing strips have upper and lower portions, said upper portion being substantially in the cross-sectional shape of an inverted trapezoid and the lower portion being substantially in the cross-sectional shape of a rectangle having its end sustantially of the same dimension as the smaller base of said inverted trapezoid.

**7**. A vibratory screen as set forth in claim **6** wherein said fibers are multistrand, and wherein said polyurethane impregnates said multistrand fibers to thereby provide an intimate bond between said dividing strips and said fibers.

**8**. A vibratory screen as set forth in claim **7** wherein said ribs comprise relatively large ribs located between relatively small ribs.

**9**. A vibratory screen as set forth in claim **1** wherein said flexible dividing strips are relatively thin and only slightly wider than said flexible aramid fibers to provide a relatively high amplitude of vibration.

**10**. A vibratory screen as set forth in claim **9** wherein said flexible aramid fibers are about 0.5 mm in diameter.

**11**. A vibratory screen as set forth in claim **9** wherein said openings are between about 1.5 mm and 3 mm between said opposite sides of said openings.

**12**. A vbratory screen as set forth in claim **9** wherein said openings are as narrow as 0.25 mm between said opposite sides of said openings.

**13**. A vibratory screen as set forth in claim **9** wherein said dividing strips are approximately 1 mm wide and wherein said flexible aramid fibers are about 0.5 mm in diameter.

**14**. A vibratory screen as set forth in claim **1** wherein said ribs include upper portions which extend upwardly above said upper surface.

**15**. A vibratory screen as set forth in claim **14** wherein said upper portions of said ribs include downwardly sloping sides for guiding material into said openings.

**16**. A vibratory screen as set forth in claim **15** wherein said dividing strips are in the shape of inverted trapezoids.

17. A vibratory screen as set forth in claim 1 wherein only a single strand of said aramid fibers is positioned in each of said dividing strips, and wherein each of said strands is about 0.5 mm in diameter.

18. A vibratory screen as set forth in claim 1 wherein said side edge portions are formed into U-shaped configurations.

19. A vibratory screen as set forth in claim 1 wherein said side edge portions are encased in U-shaped metal frames which extend longitudinally of said side edge portions.

20. A vibratory screen comprising a flexible molded polyurethane body having first opposite ends, screen openings in said body having second opposite ends, substantially parallel flexible dividing strips defining opposite sides of said screen openings, elongated flexible aramid fibers molded integrally with said flexible dividing strips to impart tensile strength to said screen while maintaining flexibility thereof, said body having side edge portions at said first opposite ends of said body between which said fibers extend to enable tensioning of said body along the length of said fibers and strips, said openings being elongated with a greater length dimension along said sides and between said second opposite ends thereof than a width dimension between said sides and with the length dimensions of said openings extending in a direction transverse to said side edge portions, said body having an upper surface and a lower surface, said openings diverging downwardly between said upper surface and said lower surface, integrally molded ribs extending transversely to said dividing strips and having portions extending upwardly above said upper surface, and said ribs comprising relatively large ribs located between relatively small ribs.

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